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Animal Keeper Forum

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The American Association of Zoo Keepers, Inc. exists to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.

ABOUT THE COVER

This month's cover photo comes to us from David Haring at Duke Lemur Center. A four-year-old Coquerel's sifaka female, Amelia, hops down a forest path on a November day. As vertical clingers and leapers, sifaka generally move through the forest by jumping from tree to tree but Amelia is more than likely responding here to the fact that it is feeding time and the pathway represents the most direct, and quickest route to the feeding station.

The DLC has nine forested enclosures, ranging in size from one acre to ten acres. During the warmer months each of the nine enclosures houses (along with other species of lemur) a pair or a small family group of sifakas, for a total at Duke of 24 (9.15) free-ranging sifaka! Amelia's group consists of her younger sister, Calpurnia and their parents, Julian and Drusilla (both 26-years-old).

The sifaka group share the enclosure (and the adjacent heated building accessible to all free-ranging animals) with a small group of ring-tailed lemurs. In the past, red-ruffed lemurs and blue-eyed lemurs have also been in the mixed-species mix in this enclosure. Getting different lemur species to co-exist peacefully, even if they are free to roam in a five-acre forest, is often challenging. Sometimes compatibility between species cannot be obtained, and an overly aggressive group has to be removed and replaced by a group (often of the same species) which, hopefully, will prove to be less aggressive.

Articles sent to *Animal Keepers' Forum* will be reviewed by the editorial staff for publication. Articles of a research or technical nature will be submitted to one or more of the zoo professionals who serve as referees for *AKF*. No commitment is made to the author, but an effort will be made to publish articles as soon as possible. Lengthy articles may be separated into monthly installments at the discretion of the Editor. The Editor reserves the right to edit material without consultation unless approval is requested in writing by the author. Materials submitted will not be returned unless accompanied by a stamped, self-addressed, appropriately-sized envelope. Telephone, fax or e-mail contributions of late-breaking news or last-minute insertions are accepted as space allows. Phone (330) 483-1104; FAX (330) 483-1444; e-mail is shane.good@aazk.org. If you have questions about submission guidelines, please contact the Editor. Submission guidelines are also found at: aazk.org/akf-submission-guidelines/.

Deadline for each regular issue is the 3rd of the preceding month. Dedicated issues may have separate deadline dates and will be noted by the Editor.

Articles printed do not necessarily reflect the opinions of the *AKF* staff or the American Association of Zoo Keepers, Inc. Publication does not indicate endorsement by the Association.

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Animal Data Transfer Forms available for download at aazk.org. AAZK Publications/Logo Products/ Apparel available at AAZK Administrative Office or at aazk.org.

ANIMAL KEEPERS' FORUM

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AAZK's role is to first represent the membership and be their voice in animal care, but secondly to build leaders.

Every once in a while there is a gap between a President completing their term and finalizing their duties on the AAZK Board of Directors, and the selection process and installation of a new AAZK President who is beginning their two-year term on the AAZK Board. My job this month is to fill that gap.

From a leadership position, AAZK is about to welcome new members to the AAZK Board of Directors. Though AAZK has not had enough candidates to hold a competitive election since 2015 which has resulted in appointments, the candidates are rich in AAZK Committee experience. Take a moment now to ask yourself "why should I not throw my nomination in the mix". AAZK's role is to first represent the membership and be their voice in animal care, but secondly to build leaders. As a Director with AAZK you will gain valuable leadership and organizational experience, while understanding how a complex business environment functions. AAZK looks good on a resume.

From a financial standpoint, AAZK maintains a very healthy bottom line which is interesting as our Affiliate and Student membership is rapidly declining. A slow but steady increase in our Professional and Institutional membership, combined with incredible support from our Chapter partners, keeps AAZK moving forward. Looking forward into 2020, AAZK will be making significant and exciting changes to our Bowling for Rhinos Program, our Professional Development programs and how AAZK manages your continuing education opportunities through AAZK Conferences and AAZK Online.

In conclusion, don't be shy about letting myself or the AAZK Board of Directors know what AAZK does right and what AAZK is doing wrong, or simply where we are not doing enough. You can reach me directly at Ed.Hansen@aazk.org.

Thank you for everything that you do for AAZK.

Ed Hansen
AAZK CEO/CFO

COMING EVENTS

Post upcoming events here!
e-mail shane.good@aazk.org

October 7-11, 2019
Giraffe Care Workshop
Colorado Springs, CO
Hosted by
Cheyenne Mountain Zoo
For more information go to:
http://www.cmzoo.org/index.php/giraffe-care-workshop/

October 7-11, 2019
"From Good Care to Great Welfare" workshop
Detroit, MI
Hosted by Detroit Zoological Society's Center for Zoo and Aquarium Animal Welfare and Ethics. For more information go to: http://www.czaw.org/events

October 17-18, 2019
Animal Training Workshop
Kansas City, MO
Hosted by Kansas City Zoo
For more information go to:
http://kansascityzoo.doubleknot.com/event/kansas-city-zoo-animal-training-workshop/2502109

October 29-30, 2019
Working Bird Husbandry Workshop
Atlanta, GA
Hosted by Zoo Atlanta
For More information contact:
ryoung@zooatlanta.org

November 1-4, 2019
Canid and Hyenid Husbandry Course
Glen Rose, TX
Hosted by Fossil Rim Wildlife Center
For More information contact:
hgenter@denverzoo.org

November 4-7, 2019
Polar Bear Workshop
Toronto, Ontario, Canada
Hosted by Toronto Zoo
For more information go to:
education.torontozoo.com/products/1099943-polar-bear-workshop-2019.aspx

January 14-16, 2020
5th Annual Animal Training Workshop
San Antonio, TX
Hosted by San Antonio Zoo
For more information go to:
sazoo.org/trainingworkshop/

March 4-7, 2020
Venom Week 2020
Gainesville, FL
Hosted by The North American Society of Toxicology
For more information go to:
reg.conferences.dce.ufl.edu/VENOM/1566

April 4-9, 2020
AZA Mid-Year Meeting
Palm Springs, CA
Hosted by The Living Desert Zoo and Gardens.
For more information go to:
aza.org/conferences-meetings

AMERICAN ASSOCIATION of ZOO KEEPERS

August 30 - September 3 2020

AAZK National Conference
Los Angeles, CA
Hosted by Los Angeles AAZK Chapter and Los Angeles Zoo

Save the date! More details to come!

September 13-17, 2020
AZA Annual Conference
Columbus, OH
Hosted by the Columbus Zoo and Aquarium
For more information go to:
aza.org/conferences-meetings

The AKF Team thanks the local AAZK Chapters that sponsored production of the AKF through a donation during this year's re-charter. Your contribution allows us to provide AAZK Members this journal every month. Thank You!

Little Rock Chapter

National Capital Chapter

Lion Country Safari Chapter

Ozarks Chapter

Rosamond Gifford Zoo Chapter

Milwaukee Chapter

Wildlife World Zoo Chapter

Cape May County Zoo Chapter

Jacksonville Chapter

Topeka Chapter

AAZK Chapters 2019
A Continuing Force in Global Conservation

Ed Hansen
AAZK CEO/CFO

The following information was compiled from the AAZK Chapter Re-charter materials submitted in 2019 and details the conservation spending by AAZK Chapters in 2018. On January 1, 2019 AAZK had **114 duly chartered Chapters** within the Association, with Chapter membership totaling **1713** individuals. **Ninety-eight** of those AAZK Chapters made contributions to fellow non-profit conservation organizations or registered charities during 2018.

In 2018, AAZK Chapters contributed **$896,433.08** to deserving groups and charities around the globe. The average donation to conservation and charity totaled **$9147.28** per donating AAZK Chapter. AAZK Chapters made **488** individual donations to **235** different non-profit or charity organizations around the world.

The primary beneficiary of the generous contributions to conservation from AAZK Chapters are our internal conservation projects, Bowling for Rhinos and Trees for You and Me. AAZK Chapters raised and donated over ½ million dollars (**$580,900.22**) for species and habitat conservation in Asia and Africa and funded two grants in conservation, the BFR Conservation Resource Grant (**$11,159.36**) and the Trees for You and Me Restoration Grant (**$20,544.53**). In addition to these two grants funded by Chapter contributions, AAZK member dollars endows Continuing Education, Conservation and Research Grants with a combined total just under **$40,000** annually for members and non-members in 2018.

After supporting AAZK Conservation programs. AAZK Chapters donated **$294,988.33** to **182** conservation projects, emergency relief, or other charitable ventures, with the highest donor total supporting the AAZK Conservation Partner **Turtle Survival Alliance**. Also included are **26 AAZK Chapters** who donated *back* to their **Host Facilities** support entity to support projects, scholarships or research within their facility or to deserving conservation projects spearheaded by other zoo or aquarium facilities.

I am often asked by zoo/aquarium directors and managers regarding the concept and purpose of AAZK Chapters. The Mission of AAZK and our Chapters is straightforward:

The American Association of Zoo Keepers exists to advance excellence in the animal keeping profession, foster effective communication beneficial to animal care, support deserving conservation projects, and promote the preservation of our natural resources and animal life.

Thank you once again to all of the AAZK Chapters and members who work so very hard, day in and day out, to reinforce the Mission and Vision of AAZK and who continue to be a force in global conservation.

114
AAZK Chapters

1713
Members

$896K
Contributed globally

235
Number of charities that received donations from AAZK

Malagasy Lemur *(Lemuriformes)* Biodiversity: How lemur diets can help identify specific niches

Rebecca Stennett
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Miami University
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Abstract

This paper explores the differences in niche specialization of five different lemur (*Lemuriformes*) species by reviewing the research on wild lemur diet and foraging data. Ring-tailed (*Lemur catta*), red-collared (*Eulemur collaris*), red-ruffed (*Varecia rubra*), and grey mouse (*Microcebus murinus*) lemurs all consume diets high in fruit. Red-ruffed lemurs are the most selective of the four species. Coquerel's sifaka lemurs (*Propithecus coquereli*) are folivorous and possess a specialized digestive tract to process a high cellulose diet. This paper demonstrates why observational research on wild lemurs is needed to develop conservation strategies focusing on small-scale, niche-specific initiatives. This synthesis of information can be used by animal keepers and zoo volunteers when conveying conservation messages to the public. With Madagascar's biodiversity under severe threat due to habitat loss and hunting, strong conservation efforts are needed.

Introduction

The island of Madagascar, off the southeast coast of Africa, has been identified as a biodiversity hotspot. Hotspots are classified as areas of the globe with both high amounts of endemism, as well as significant loss of overall primary vegetation cover. Myers et al. (2000) stated that Madagascar retains only 10% of its original primary vegetation cover and that 80% of the plant species and 78% of the vertebrate species are endemic. This high percentage of endemic plant species has allowed for the speciation and niche differentiation of many different species of lemurs (Mittermeier et al., 2008). Because the biodiversity of Madagascar is threatened, it is possible that species of lemurs will go extinct before they are discovered. In fact, 39 of the 99 Malagasy lemurs have been discovered in just the last 16 years (Mittermeier et al., 2008).

Recent analysis of the conservation status of lemur species discovered that the infraorder *Lemuriformes* as a whole is threatened with extinction. The economic and political environment in Madagascar has exacerbated the lemurs' situation. In 2009, the Malagasy government had an unconstitutional shift in power that ended the democracy. This resulted in decreased support to protected forests and economic instability for the country's people. Not only did internal funding for Malagasy conservation efforts decrease, but international support was withdrawn, as well. Governments, such as the United States, denied support until Madagascar reinstituted a democratic government. This already poor population turned to the island's natural resources, logging and bushmeat, posing increased risks to the endemic lemurs (Schwitzer et al., 2014).

In addition to economic and political threats, their risk of extinction increased due to habitat loss, as well as new species discovered by improved genetic research (Schwitzer et al., 2014); by redefining the specific lemur species through genetic analysis, researchers discovered that Madagascar is home to many more species than initially believed. Therefore, not only is the island divided into smaller, more specialized ranges and niches, but also the lemur population as a whole is now divided into a larger number of species with fewer individuals (Schwitzer et al., 2014). Donati et al. (2007) described Madagascar as an island, "... characterized by low plant productivity, irregular phenological cycles and climatic extremes, making [it] a harsh place for primates," (p. 1247). This description of Madagascar lends support to the reason for the variety of lemurs and specialized niches among the Malagasy prosimians. In order for more than 99 species of lemurs to cohabit this unique island, the evolution of specialized adaptations and, thus, niches was required by each of the different species. In order to combat the imposing threats on lemurs, Schwitzer et al. (2014) proposed that cost-effective, small-scale, site-specific conservation strategies, such as the sites delineated by Figure 1, will be essential to saving lemur species.

Lemur niches are defined by the type of habitat a species lives in and the food it consumes; thus, saving specific forests is mandatory for lemur conservation. Understanding the characteristics and adaptations that define these niches can greatly aid in conservation efforts. Niches can help answer questions about whether a species' diet is flexible or if it needs specific vegetation to survive. By understanding the specialized diet of different lemur species, conservation strategies can focus on ensuring the correct habitat is protected. Many researchers and scientists have conducted observational behavioral research as well as laboratory dissections to try and address this topic. This review paper compares the diet and foraging behavior of five different Malagasy lemurs commonly housed in zoos - ring-tailed, red-collared, red-ruffed, grey mouse, and Coquerel's sifaka. Evaluating where the nutritional niches of these lemur species compare and contrast will allow for identification of habitats with high conservation potential and illumination of areas needing future research in order to form effective conservation efforts. By aiding in the survival of lemur species, conservationists will also be preserving the island's unique ecosystems (Schwitzer et al., 2014).

Ring-tailed Lemur

The ring-tailed lemur species was discovered by Linnaeus in 1758. Not only has the ring-tailed lemur been identified as, "...the only surviving semi-terrestrial, diurnal lemur in Madagascar," but it has also been more profusely studied than the other lemur species (Mittermeier et al., 2008, p. 1632). These well-known, medium-sized lemurs have been observed living in different types of environments found in southern Madagascar (Mittermeier et al., 2008). Due to the early discovery of the ring-tailed lemurs, there have been multiple observations regarding their diet, some of which are contradictory. Jolly (1966) believed that ring-tailed lemurs ate a diet containing mostly fruit and seeds. As observational research continued on the ring-tailed lemurs, conclusions shifted between whether fruit and seeds or leaves, shoots, and stems defined the majority of the species' diet (Godfrey et al., 2004). When Rasamimanana and Ratidinarivo (1993) presented their findings that leaves, shoots, stems and fruits and seeds make up equal parts of the diet, they contradicted the previous findings.

Then in Yamashita's study (2002), some light was shed on the reason for the previous discrepancies. Ring-tailed lemur groups living in close proximity to each other, but with different microhabitats, were studied to see how the plant species present affected a group's overall diet (Yamashita, 2002). Among all of the ring-tailed lemur groups, 54 plant species were consumed, but the kily fruit from the *Tamarindus indica* tree was found to be the most important and prevalent part of the diet for all of the lemurs (Yamashita, 2002). The other components of the ring-tailed lemur diets in these groups came from a variety of species and parts of plants that did not have a strong overlap between ring-tailed lemur groups (Yamashita, 2002). Thus, if kily fruit was available, the ring-tailed lemurs heavily preferred that food item, but if the kily fruit was not present, then the species consumed a very generalistic-type diet. These results are important not only

for explaining why previous research could yield different results and still be accurate, but also for identifying a very important component to the ring-tailed lemur's niche - the kily fruit.

Red-collared Lemur

The red-collared lemur's niche has been found to be driven by the presence of fruit, as well. The red-collared lemur was identified as a distinct species in 1812 by E. Geoffroy. This medium-sized lemur inhabits the southeastern region of Madagascar (Mittermeier et al., 2008). These lemurs are an example of a cathemeral species, meaning they are active at varying times throughout the 24 hour period in a day (Donati et al., 2007). Cathemerality suggests that a species is more flexible in terms of what conditions it needs to survive. Being active during both light and dark hours presents different benefits and challenges. Presence of other animals differs depending on the time of day. Therefore, one theory of cathemerality is that varying activity patterns of a species can help evade predators and conserve energy (Donati et al., 2007).

In the case of red-collared lemurs, cathemeral activity patterns have led to diverse and flexible diet and foraging practices. In fact, observations found that fiber and fruit play a larger role in determining the hours of collared lemur activity than the presence of predators (Donati et al., 2007). This finding supports the idea that the diet and nutrition of different lemur species is an important factor that strongly drives niche development and speciation. Donati et al. (2007) demonstrated this by providing observations that red-collared lemur activity patterns vary depending on the season and availability of ripe fruit. When ripe fruit was abundant, collared lemurs foraged more during daylight, the preferred foraging time due to decreased predator presence. However, when fibrous, unripe fruit was more common, the lemurs foraged both during the day and at night, choosing from 120 different plant species. The reason for this difference in foraging based on ripeness is that they had to eat more unripe fruit to consume the same nutrients in comparison to ripe fruit (Donati et al., 2007). The conclusion from these observations is that because red-collared lemurs do not have the traditional adaptations to account for seasons of low-quality food (torpor or specialized digestive tracts) the species instead must eat a higher volume of the fibrous fruit to obtain all of the required nutrients (Donati et al., 2007).

Red-Ruffed Lemurs

The red-ruffed lemurs are dependent on fruit, like the ring-tailed and collared lemurs; however, red-ruffed lemurs are more selective. Red-ruffed lemurs were named as a species by E. Geoffroy in 1812 and inhabit the northeastern Madagascar rainforests in the Masoala Peninsula. Rigamonti (1993) conducted a study on the home-range and diet of red-ruffed lemurs. His observations determined that these diurnal-crepuscular lemurs were selective in many ways. The first is that red-ruffed lemurs had a very distinct habitat. They depended on mature rain forests with large fruit trees that had an average diameter at breast height of 59.8 centimeters, or 23.5 inches (Rigamonti, 1993). The lemurs depended on these large trees for eating, sleeping, and resting. In correlation to the high amount of time spent in these trees, the red-ruffed lemurs were mainly frugivorous, although they did occasionally eat leaves and flowers. In addition, they were only observed consuming ripe fruit and flowers in full bloom (Rigamonti, 1993). The red-ruffed lemurs' selectivity continued in that they were observed eating from 42 different plants species, but 72.5% of their consumption was from only 7 of these plant species (Rigamonti, 1993). This selectivity by red-ruffed lemurs differs from the niche held by red-collared lemurs because the collared lemurs were observed foraging from 120 plant species, and the author did not denote any preferred plant species (Donati et al., 2007).

Grey Mouse Lemurs

The grey mouse lemur was classified as a species by J.F. Miller in 1777. The small, nocturnal prosimian lives on the western coast of Madagascar, in the evergreen littoral forests (Mittermeier et al., 2008). In contrast to the normal prediction for small primates, the grey mouse lemur's diet does not consist of a high percentage of insects (Lahann, 2007). Instead, the small prosimian mainly eats small fruits and a lesser percentage of the diet is flowers, similar to the three previously discussed species. However, Lahann (2007) observed that the grey mouse lemur fed at a specific height, which is on average four meters high. The researcher discovered that feeding height on a tree defined the grey mouse lemur's niche in comparison to two other mouse lemur species in the same habitat (Lahann, 2007). The grey mouse lemur was observed foraging from 70 different plant species, favoring plants from four specific families (Lahann, 2006). In summary, the grey mouse lemur is mid-range on the scale of selectivity. Grey mouse lemurs tend to consume more plant species than the red-ruffed lemurs but are not as generalist as the ring-tailed or red-collared lemurs.

Coquerel's Sifaka

In contrast to the previous four lemur species, the sifaka lemur's niche is defined by leaves instead of fruit. The Coquerel's sifaka was determined by Grandidier in 1867. These large, diurnal lemurs live in northwestern Madagascar, in the dry deciduous forests (Mittermeier et al., 2008). In general, sifakas consume 70 different plant species and eat tougher food than other species of lemur (Yamashita, 2002). Coquerel's sifakas are folivorous, meaning they rely on the leaves from plants (Campbell, Eisemann, Williams, & Glenn, 2000). In a study conducted by Campbell et al. (2000), the gastrointestinal tracts of five different lemur species were compared (Figure 2). Coquerel's sifakas have the longest cecum, colon, and small intestine compared to ring-tailed lemurs, ruffed lemurs, bamboo lemurs, and other species of sifaka (Campbell et al., 2000). This difference in anatomy has allowed for Coquerel's sifakas to more easily digest and absorb nutrients from food materials with large amounts of cell walls that contain cellulose (Campbell et al., 2000). Not only is the digestive tract of Coquerel's sifakas longer than other lemur species, but the tissue is also significantly more vascularized, suggesting that more energy, overall, is devoted to digesting food particles and extracting nutrients (Campbell et al., 2000). In addition to enabling the sifaka to inhabit a distinctive niche consuming

leaves, this gut specialization has also allowed the species to tolerate natural disasters, such as droughts, because they can consume all stages of leaves (Yamashita, 2002).

Conclusion and Further Research

Although this paper has been able to compare the general niches of these lemur species based off their diets, it is important for research to continue. This need for continued research is evident with the on-going new observations made through extensive research on ring-tailed lemur diet composition. Four different studies had varying results for the ring-tailed lemurs, and it took a fifth study to explain the possible cause of these variations. Studies similar to the microhabitat comparison across one species conducted by Yamashita (2002) would benefit conservation. Yamashita's (2002) study allowed for the construction of a more concrete definition of ring-tailed lemur's niche. Studies of niche differentiation within the same genus among lemur species is also greatly needed. There was limited information about Coquerel's sifaka, especially with regards to dietary components that separate them from other sifaka species. Another avenue for future research was highlighted in the Donati et al. article (2007). The authors stated that interspecific competition for food could have also driven collared lemur cathemerality leading to the development of the collared lemur's specific niche. However, more research needs to be done before this conclusion can be fully drawn. This concept of interspecific competition for food could be used to examine the niches of other lemur species where limited research is available about their diets and niches.

Another area needing further research that was discovered while researching this paper regards the conservation of red-ruffed lemurs. Overall, red-ruffed lemurs are the most specialized of the five lemur species discussed because they require specific sizes of trees, ripened fruit, and specific plant species. Mittermeier et al. (2008) wrote that red-ruffed lemurs are highly threatened by the bushmeat trade and habitat destruction. Due to the fact that red-ruffed lemurs depend on mature, primary rain forest, the species is exceptionally susceptible to logging and forest clearings. Mittermeier et al. (2008) urges for more conservation research to be done to determine what protective measures can be taken and to determine whether there are more species in the *Varecia* genus; it is important to know if there are more species within the genus so that the individual niches can be adequately protected.

Future research on lemur speciation and niche development has many implications for conservation. In addition to *in situ* conservation impacts, niche research will potentially affect *ex situ* efforts, as well. A better understanding of what specifically drives wild lemur food choices can help assess and reevaluate the diets fed and enrichment items provided by zoos to captive lemurs. Captive populations provide a method for educating and connecting people from all over the globe with the plight of Madagascar; with this heightened awareness, the support for slowing the extinction rate should increase. *Ex situ* facilities also participate in captive breeding in order to maintain self-sustaining lemur populations. These captive populations act as a reserve gene pool in case conservation strategies in Madagascar call for reintroduction efforts. Better comprehension of lemur diet and niches will lead to healthier, more natural captive lemur populations. Therefore, future research on lemur speciation and niche development is essential to the local and global, *in situ* and *ex situ*, conservation success of Malagasy lemurs.

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Reproductive Trends in Silvered Leaf Langurs (*Trachypithecus cristatus*) at the San Diego Zoo

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Abstract

This is an overview of the reproductive data recorded from the silvered leaf langurs (*Trachypithecus cristatus)* at the San Diego Zoo from June 2014 to November 2017. Behavioral observations from 13 pregnancies allowed for the identification of trends in reproductive behavior and indicators of pregnancy progression. These trends have provided a predictive tool that has refined our ability to estimate date of parturition without reliance on hormone testing or ultrasound. After conception, females had an average 44.4 day period without any observed sexual behavior (n=8). Frequent, repeated sexual behavior resumed an average of 60.1 days after conception (n=7). The last observed sexual behavior occurred an average of 96.2 days prior to parturition (n=5). Gestation length was an average of 200.9 days, with a range of 198-208 days (n=9). Primiparous and multiparous females had an average cycle length of 24.5 days (n=12) and took an average of 2.5 cycles to conceive (n=6). Additional data have been included on weight gain during gestation, interbirth intervals, female sexual maturation, and infant development. Information on the reproductive trends of this group of silvered leaf langurs is provided to increase the database of these areas of life history for this species in captivity. The signs of pregnancy progression may be useful for keepers working with this or similar species as they monitor the reproductive status of the animals in their care.

Introduction

Silvered leaf langurs (*Trachypithecus cristatus*) are a medium-sized leaf monkey native to Southeast Asia. This species is classified as Near Threatened, and their current range includes Indonesia, Malaysia and Brunei (Nijman & Meijaard, 2008). They live in bisexual groups of 12 to 42, with one to two fully adult resident males. As is observed in many colobine species, silvered leaf langurs practice allomothering. It is hypothesized that this not only allows the mother to feed more efficiently, but also provides other group members with valuable experience caring for an infant (Rowe, 1996).

Silvered leaf langurs, like many colobine species, do not have sexual swellings to advertise receptivity (Shelmidine et al., 2007). Females solicit males for breeding by presenting to the male, which is usually accompanied by shaking their head from side to side. Presenting behaviors can also be used as a submissive gesture and occur between females as well as between the sexes. Even the more typical soliciting behavior of presenting with simultaneous head shaking is occasionally used by juvenile males as a submissive gesture towards more dominant males (Wolf, 1984).

Females continue to solicit males for breeding several months into their pregnancy (Shelmidine et al., 2009), which can make it difficult to determine date of conception. Without hormone testing, ultrasounds or radiographs, it can be challenging to diagnose pregnancy early in the gestation period. Once a pregnancy is confirmed, it can be difficult to accurately predict date of parturition. Determining the characteristics of menstrual cycles and pregnancy is necessary to allow an accurate diagnosis of the reproductive status of females. Through analyzing behavioral observations and morphological changes, I have identified trends in the reproductive behavior and characteristics of pregnancy for the population of silvered leaf langurs at the San Diego Zoo. These trends allow for more accurate estimation of dates of conception and parturition.

Reproductive life history data have been reported for this species housed at the Bronx Zoo (Shelmidine et al., 2009). However, species specific characteristics can vary widely within the species due to environmental conditions. Ecological and social factors can cause significant variation in age at first parturition, gestation, lactation periods, interbirth intervals and infant development (Borries et al., 2001; Borries et al., 2008).

Three-month-old infant. Photo by Helene Hoffman.

Methods

Study Group and Study Periods

In June 2014 a group of 5.8 silvered leaf langurs was moved from an off-exhibit area into an exhibit in the Heart of the Zoo area of the San Diego Zoo. This paper reports on trends within the group from June 2014 to November 2017. When the group was moved to the exhibit, keepers were initially focused on identifying individuals, building relationships, and training the group to shift on and off exhibit. One female conceived shortly before being transferred to the exhibit, and three females conceived during the summer of 2014. Breeding behavior was not being recorded at that time, but the progressions of the pregnancies were recorded and are included in the data presented here. Beginning in March 2015, all observed reproductive behavior was recorded. December 2014 to July 2015 was a period of great change with births, deaths and transfers. In July 2015 all remaining males were moved out of the exhibit and the group became 0.7. In October 2015, 1.3 new individuals were introduced. Throughout the study period, group size varied from 7 to 18 individuals. The number of adult males present in the group ranged from 0 to 3 and the number of adult females from 4 to 9. Most of the results are based on observations made when only one adult male was present in the group (October 2015 to November 2017).

Data Collection and Analysis

The data presented is based on keeper observations as they go about their regular schedule. There are no set times for observations or sampling. Day keeper hours are 06:00 to 14:30, with a late keeper shift that varies seasonally to end between 17:30 and 20:00. Most observations are recorded by the day keeper working the area but any observations noted by the late keeper or any other keeper are recorded in daily keeper records. These data are presented with the caveat that there will be holes in the data (reproductive behaviors that were not observed and recorded) since keepers are not always present to observe and there is not a camera system recording their behavior. Additionally, not all keepers are sufficiently familiar with this group of langurs to differentiate between individuals. During the study period (June 2014-November 2017) there were 13 known pregnancies from seven females.

Reproductive behavior was categorized similarly to Shelmidine et al. (2009). Proceptive behavior included any female solicitation: presenting of anogenital region, lateral head shaking, or both presenting and head shaking simultaneously. Receptive behavior included: mounting by the male (no intromission) or copulation (with notes made on possible, probable or confirmed intromission). Vaginal bleeding was recorded when observed. However, females were not systematically checked daily, so all occurrences of bleeding may have not been observed.

Two-year-old female alloparenting her three-week-old sibling. Photo by Debbie Beals.

Results and Discussion

Cycle Length

Since nulliparous females tend to show continuous or irregular sexual behavior (Dixson, 2012), average cycle length was calculated twice, first using only primiparous and multiparous females, then again including nulliparous females. Parous females had a mean cycle length of 24.5 ± 1.9 days (n=12, range 22-29, median 24). The mean cycle length when nulliparous females were included was 25.5 ± 2.7 days (n=32, range 21-34, median 25).

Vaginal Bleeding

From March 2015 to June 2017, vaginal bleeding was observed 15 times in cycling females and considered to be menses. Vaginal bleeding in cycling females occurred a mean eight days prior the receptive period (n=10, SD = ± 2.8, range 4-12, median = 7.5). Postpartum bleeding has also been observed on days 1-13 after parturition.

Number of Cycles to Conceive

Primiparous and multiparous females took an average of 2.5 ± 1.0 cycles (n=6, range 1-4, median 2.5) to conceive once they resumed cycling following the birth of their infant. (Note three cycles to conceive implies conception occurred during the third cycle).

Female Sexual Maturity

The first observed blood around the vaginal area of nulliparous females occurred at 25.2 ± 0.5 months of age (n=3, range 24.6-25.7, median 25.1). Due to the nature of observations, the possibility of blood being from an abrasion rather than vaginal bleeding, and the irregularity of menstrual bleeding in nonhuman primates this is not necessarily reliable as age of menarche.

Since presenting behavior can also be a submissive posture, a more significant milestone is the first observed solicitation of a male that includes both presenting and head shaking, and appears to be an invitation for copulation. This was observed at an average age of 29.3 ± 0.4 months (n=3, range 28.8-29.6, median 29.4). This was the onset of monthly (~25 day) cycles, though some irregularity was observed, as is common with nulliparous females. The first receptive behavior was observed at 29.8 ± 0.5 months (n=3, range 29.4-30.4, median 29.6). One nulliparous female took 9.6 months to conceive (12 cycles). Another nulliparous female had not conceived after 12.5 months (14 irregular cycles).

The age at first birth was only observed for two individuals in the study group, at 3.5 and 3.8 years old. Another female in the group had not conceived by 3.6 years old. This is considerably later than the average 2.9 years at first birth reported by Shelmidine et al. (2009). Parturition at 2.9 years (34.6 months) corresponds to an average age at first conception of approximately 28 months. As stated above, the females in this study group did not start showing full cycling behavior until an average of 29.3 months. However, as Shelmidine et al. (2009) point out, their observed value is more than one year younger than other captive or provisioned colobine species. Due to the very small sample size in the study group for this value, not many conclusions can be drawn. At this time, the average age at first birth is considerably older than that reported in Shelmidine et al. (2009).

Female genital swellings are observed both during and outside of pregnancy (Shelmidine et al., 2007). Therefore, data were not recorded on genital swellings. Anecdotally however, genital swellings were commonly observed in pregnant females in the study group. Though the

general sense is that swellings are larger and more persistent during gestation, their occurrence outside of pregnancy makes them an imprecise indicator of pregnancy.

Postconceptive Sexual Behavior

In a population of silvered leaf langurs at the Bronx Zoo, Shelmidine et al. (2009) observed that pregnant females copulated regularly soon after conception and the behavior continued until a few days before parturition, with the highest frequency of proceptive behaviors occurring between 50 and 100 days post-conception.

Within this study group there was an average 44.4 ± 20.2 days (n=8, range 9-62, median 54) between the end of the conceptive receptive period and the next proceptive behavior and a mean of 55.4 ± 16.2 days (n=8, range 18-71, median 59) between the end of the conceptive receptive period and the next receptive behavior. However, incidences of sexual behavior prior to 54 days after conception were rare and were typically isolated incidences of females soliciting a male. The resumption of frequent, repeated sexual behavior occurred on average 60.1 ± 5.9 days (n=7, range 54-70, median 61) after conception.

Data on sexual behavior was only recorded for one pregnancy in which multiple males were present. This is the only pregnancy in which receptive behavior was seen prior to 54 days after conception. The female was mounted by the subordinate subadult male, while the adult dominant male did not show any interest. In situations with only one adult male present, there was an average 48.1 ± 18.6 days (n=7, range 9-62, median 54) between the end of the conceptive receptive period and the next observed proceptive behavior and an average 60.7 ± 6.3 days (n=7, range 54-71, median 62) before the next observed receptive behavior.

The last observed proceptive behavior prior to parturition was an average of 105.6 ± 6.2 days (n=5, range 99-112, median 108) after the conceptive receptive period and a mean 96.2 ± 6.2 days (n=5, range 86-101, median 98) prior to parturition. The last observed receptive behavior prior to parturition was an average of 72.3 ± 23.2 days (n=4, range 55-99, median 67.5) after the conceptive receptive period and a mean 130.5 ± 20.5 days (n=4, range 101-145, median 138) prior to parturition.

To summarize, the following trends were observed for this study group:

A. After conception, almost no sexual behavior until day 54
B. Thereafter, many solicitations and copulations until around day 72
C. Copulations are no longer observed after 72 days, solicitations continue until about 106 days
D. Thereafter, until term around day 201, almost no further sexual behavior

Sexual behavior prior to 54 days after conception was only rarely observed and sexual behavior in the last trimester of the gestation period was only observed once. It is possible that sexual behaviors occurred at other times during the gestation, as observed by Shelmidine et al. (2009) and were at such low frequency as to avoid detection. The observations from this study are similar to those observed by Shelmidine et al. (2009) and show similarities to observations in free-ranging Hanuman langurs (*Semnopithecus entellus*) (Sommer et al., 1992; Ziegler, 2000).

Mating during pregnancy may serve to confuse paternity and this may be useful in groups with multiple males, or when a male is replaced as a strategy to prevent infanticide (Ostner et al., 2006). Studies show that postconceptive mating primarily involves adolescent males as opposed to older, experienced males who may be better at detecting fertility (Ostner et al., 2006; Lu et al., 2012). During this study, the only time receptive behavior was observed during early pregnancy was a few instances of a subadult male attempting to mount a pregnant female. This was the only pregnancy in which records were kept when multiple males were present. For many of the data presented here (from October 2015 to November 2017), only one adult male was present and he was 19-years-old when the study began. The patterns of postconceptive breeding in this study group may have been different if multiple or less experienced males were present during more of the study period.

Gestation

Mean gestation length for the study group at the San Diego Zoo was 200.9 ± 3.3 days (n=9, range 198-208, median 200). An average gestation of 194.6 ± 6.4 days (n=7, range 181-200, median 197) was recorded for silvered leaf langurs at the Bronx Zoo (Shelmidine et al., 2009). Both results are based on a fairly small sample size and each is affected by data points at different ends of the spectrum (181 days and 208 days). Both groups show a similar median value and are comparable to the gestation data for related species (see Shelmidine et al., 2009 for an overview).

Weight Gain and Changes in Appearance of Abdomen

During gestation, females gained an average of 1.5 ± 0.4 kg (n=10, range 1.1-2.2, median 1.5) or 28.2 ± 8.7% of their body weight (n=10, range 16.0-43.8, median 27). For two of the females in our study group, historical data are available from pregnancies occurring 2009-2011. Including these data, the mean weight gain was 1.4 ± 0.5 kg (n=14, range 0.8-2.2, median 1.3) or 26.8 ± 10.0% (n=14, range 14.2-43.8, median 22.4).

For the first set of pregnancies that were observed in the group, breeding behavior had only been observed for one individual (prior to study period, data passed on by former keeper). When the group moved to their new exhibit, data were initially not collected on reproductive behavior. The first indications that the females were pregnant came from a noticeable increase in the size of their abdomen or when they began to "look pregnant". While this is a very subjective observation, I chose to include it here as it may be useful for others to estimate rough date of parturition if their females begin to "look pregnant". Since this is a gradual and continuous process, exact dates cannot be assigned to when the change occurred. However, using approximate dates based on when noticeable changes

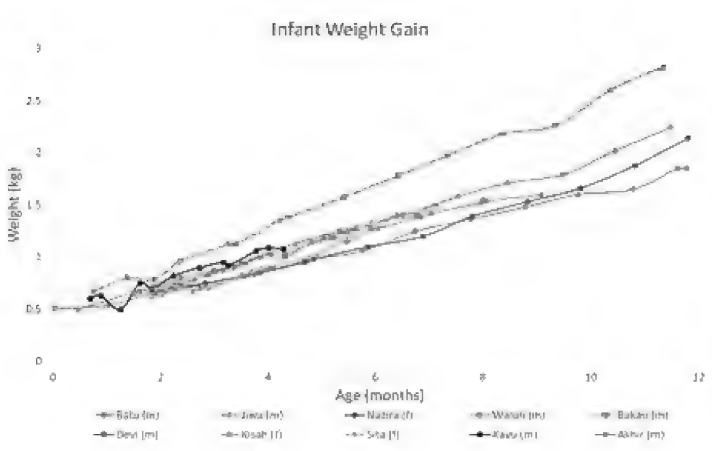

Figure 1. Comparison of Infant Weights.

in belly size were recorded gives a mean of 3.3 ± 0.7 months after conception (n=12, range 1.9-4.7, median = 3.4), which is approximately 3.3 months prior to parturition. The general trend observed was that females began to have a noticeably larger belly about halfway through their gestation. However the large range is noteworthy. Though in most females an increase in belly size was noted about three months before giving birth, in one female this was only observed two months prior to parturition. Another female began to show signs over 4.5 months prior to delivering. Now that we are more closely monitoring the breeding behavior of our females, making these observations has become increasingly complicated. With the initial four pregnancies we had no assumptions about the females being pregnant. But now when behavioral trends lead us to suspect a female is pregnant, we are on the lookout for slight changes in the size and shape of the abdomen. This may lead to noticing these changes earlier, and thereby altering the above length of time before parturition. Another complication is that several of our multiparous females have stayed very large after giving birth. While it is possible to detect a change in the appearance of the abdomen in these cases, it is not as obvious as in a leaner female.

Interbirth Interval

The mean interbirth interval was 18.5 ± 5.7 months (n=15, range 9.3-32.5, median 16.9). This includes all known intervals and is effected by stillbirths, miscarriages, and periods without a male in the group. For intervals with no extenuating circumstances (the previous infant survived, no miscarriages, male present during entire interval), the mean was 15.7 ± 1.4 months (n=7, range 13.9-17.2, median 15.8). The observed interbirth interval was slightly longer than the 14.9 ± 4.4 months observed by Shelmidine et al. (2009). Comparable values are reported for other Asian colobine species (see Shelmidine et al., 2009 for an overview).

Birth Times and Outcomes

From June 2014 to November 2017, we observed 13 pregnancies. Ten live infants were born and three were stillborn. One of the stillbirths occurred in conjunction with other health complications of the mother and the infant was delivered by Caesarean. For the other 12 births: nine occurred overnight and the infant was discovered by keepers the next morning; one birth occurred in the early evening and the infant was discovered at 6:45 pm; two females were observed to be in labor in the early afternoon. Both of the afternoon labors were dystocia cases which required veterinary intervention to remove the stillborn infants.

Infant Development

Infants are born bright orange with pale skin. We have observed slight color variation amongst infants from a yellow-orange to a burnt orange. Some infants exhibit gray hair on their brows at birth. Color change starts around 1-1.5 months, as the hands and head begin turning gray. This is followed by the feet, tail, forearms, and slowly spreads to the rest of the body. The color change is gradual, with the hair on the thighs the last area to turn gray, at around five months. An orange tinge is sometimes visible in the hair of the thighs until around six months of age.

Neonates are able to cling securely from birth and females will run and jump without supporting the infant. Infants are very popular and are passed around between group members. They are of particular interest to young females, though all females and even some young males are eager to hold them. Adult males have been observed holding infants but it is a rare occurrence. The alloparenting can be intense as everyone wants to inspect the new addition. Infant transfers can be rough as individuals are not always amenable to relinquishing their turn. The dam may have to chase caregivers to retrieve the infant. Fights have broken out that appear to be instigated by the mother's attempts to retrieve her infant. Alloparenting is most frequent in the first few days after birth. Thereafter, older females seem to lose interest, though they will generally respond if the infant is in distress. Young females are observed to be the primary caregivers after the dam.

Silvered leaf langur infants are precocious and by 10-days-old infants are very interested in their surroundings and are reaching out from their caregivers to try to grasp objects. They have been observed climbing on the wire of our holding area as young as six-days-old. By 2-3 weeks old they are confidently climbing wire mesh on their own, as long as caregivers are nearby. At 4-5 weeks they are mouthing solid foods. By two months they are coordinated enough to climb confidently on wide perches in our outside exhibit, as long as someone is within a few feet. Infants learn to jump around 2-3 months old. Around six-months-old the infants will shift into holding on their own, sometimes several minutes before their mother. As they near 12-months-old,

Infant	Weight (kg)	Age (days)
stillborn fetus (f)	0.42	0
stillborn fetus (f)	0.39	0
stillborn fetus (m, possibly preterm)	0.38	0
Dianne (f, hand-reared)	0.36	2
Kisah (f)	0.51	1
Jiwa (m)	0.5	14
Kayu (m)	0.6	21
Batu (m)	0.5	23
Waluh (m)	0.67	23
Kayu (m)	0.63	27
Kisah (f)	0.54	31
Kayu (m)	0.5	38
Waluh (m)	0.8	42
Jiwa (m)	0.66	45
Akhir (m)	0.65	46
Akhir (m)	0.67	49
Kayu (m)	0.75	49
Sita (f)	0.62	56
Nazira (f)	0.67	56
Kayu (m)	0.7	56
Devi (m)	0.64	57
Waluh (m)	0.78	57
Kisah (f)	0.68	60

Table 1. Early Infant Weights.

infants are fairly independent during active periods, but are still occasionally carried by their mother, still observed nursing multiple times during the day, and continue to sleep clinging to their mother's abdomen. Some juveniles are needier than others. When scared, a 1.5-year-old juvenile was carried by her mother, who was also carrying a four-month-old infant.

The youngest infant weight obtained was from a parent-reared female that weighed 0.51 kg at one day old. Infant weights shown in Table 1 (weights from first 60 days of age) and Figure 1 (infant weight comparison for first 12 months) show a fair amount of individual variation. One infant, Waluh, is growing at a considerably faster rate than the others. His mother and older sibling are also considerably larger than others of their age class. This infant seemed to progress a bit faster in terms of coordination and climbing skills, but this is likely a byproduct of having a less attentive dam, as he was more likely to get left on his own than other infants. His sister, while growing much faster than other females, did not begin to menstruate or cycle at an earlier age than other females.

Borries et al. (2014) makes a case for defining weaning as the cessation of nipple contact. Though milk transfer may have ceased earlier and the nipple is serving more as a pacifier, cessation of nipple contact (and with it prolonged close ventro-ventral body contact) is a good measure of offspring independence and the ability to survive on their own. During this study period, weaning was recorded for five infants, with the average observed last nipple contact at 15.2 ± 3.4 months (n=5, range 10.8-20.1, median 14.3). In two of these instances weaning was prompted by the birth of a sibling, with the last observed nipple contact at one day and 11 days after birth of the sibling. Shelmidine et al. (2009) observed an average lactation period of 12.1 ± 2.9 months in silvered leaf langurs (n=9, range 8.4-17.4 months). Communal nursing was never observed within the study group. Even when three infants were born within five weeks, females were only ever observed nursing their own infant.

Conclusion

Predictive Use of Reproductive Data

Pregnancy in silvered leaf langurs may be suspected if no sexual behavior is observed beyond the typical interval between cycles (~25 days). If these trends continue to hold true, this would allow for a preliminary diagnosis of pregnancy earlier than generally available through hormonal sampling (Lu et al., 2010). Pregnancy can be confirmed by observing if the female follows the trend outlined below:

Summary of Pregnancy Progression:
Copulation during short (average 4.3 day) period (Shelmidine et al., 2009)
Almost no sexual behavior for 54 days.
Frequent, irregular sexual behavior from an average 60 to 106 days after conception. Around this time (3-3.5 months prior to birth), noticeable increase in size of abdomen. For the last ~100 days no sexual behavior and significant weight gain. Parturition at around 201 days. In certain cases there are additional challenges to the interpretation of the timing of reproductive behaviors. Gaps in cycling behavior can be caused by pregnancy, but are also seen in the irregular cycling of nulliparous females. Older females can also be a challenge. These females may show less cyclical and more irregular sexual behavior as they near a postreproductive state (Borries & Koenig, 2008). Additional time is needed in these cases to determine if observed gaps in sexual behavior are due to pregnancy or simply irregularity.

These results are presented with the caveat that not every instance of reproductive behavior was observed and recorded because of the limitations on observation time. The data presented here are from a small sample size and individual animals may vary from this trend. Even given the constraints of this study, useful information can be gained to further the understanding of the reproductive characteristics of this species. Since the environmental

	Mean	SD	Range	Median	n
Gestation	200.9 days	3.3	198-208	200	9
Cycle length (parous females)	24.5 days	1.9	22-29	24	12
Cycle length (all females)	25.5 days	2.7	21-34	25	32
Age at first menses	25.2 months	0.5	24.6-25.7	25.1	3
Age at first full solicitation	29.3 months	0.4	28.8-29.6	29.4	3
Cycles to conceive	2.5 cycles	1	1-4	2.5	6
Weight gain during pregnancy	1.5 kg	0.4	1.1-2.2	1.5	10
% weight gain	28.2%	8.7	16.0-43.8	27	10
Interbirth interval	18.5 months	5.7	9.3-32.5	16.9	15
Weaning	15.2 months	3.4	10.8-20.1	14.3	5

Table 2. Summary of Reproductive Characteristics of Silvered Leaf Langurs at the San Diego Zoo.

conditions will be very different in a zoo setting than in the wild, caution should be used when extrapolating these data to wild populations. My intention is that the information provided here can be used to supplement Shelmidine et al. (2009) by adding data from another population to increase the knowledge base for this species.

Further research into the reproductive trends of silvered leaf langurs at the San Diego Zoo would benefit from increased and standardized observation times. This could be achieved through the use of interns, volunteers, or dedicated staff time. The installation of a camera system would allow for all occurrence sampling, which would significantly contribute to the results. Hormone testing and training for voluntary ultrasounds would be useful for corroborating reproductive statuses determined through behavioral observations.

One-month-old infant. Photo by Debbie Beals

Juvenile langur. Photo by Helene Hoffman

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2019 American Association of Zoo Keepers, Inc. Awards

Lifetime Achievement AAZK Professional Service Award

Heather Vizal, Happy Hollow Park and Zoo. This award is in recognition of her outstanding commitment to professionalism in her distinguished career as a zookeeper. During her 30-year career, which includes holding roles from zookeeper to acting director and now as the curator, her unique blend of compassion, grit and tenacity has set her apart. Specifically noted is her adoption of the Whole Life Training Program which positively impacts animals, staff and volunteers. This merit-based program was listed by the AZA as an exemplar for other facilities and demonstrates her commitment to the wellbeing of staff and animals alike. Also notable is her support and direct involvement in fundraising for the zoo's annual Heart of the Congo event and her coordination of the zoo's "Jeans for Giraffe" conservation initiative, collecting more jeans than any other participating facility. She was awarded "The Change Makers Medal of Honor" for demonstrating a career-long investment in animal welfare. She demonstrates courage and compassion in times of crisis and loss and has always worked to bring and uphold the best practices in the field. She is a highly valued member of her staff with a distinguished work record and high personal integrity. Heather is a great example of leadership and professionalism and most deserving of this award.

Lifetime Achievement AAZK Meritorious Service Award

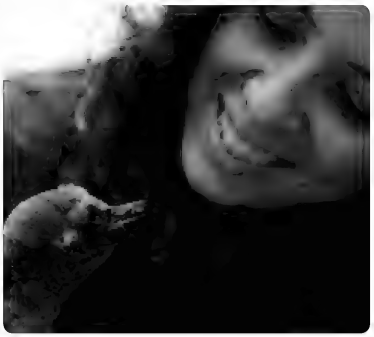
Paul Breese
Honolulu Zoo Director Emeritus. Paul Breese served as director of the Honolulu Zoo from 1947 until his retirement in 1965, and was highly respected in his field. Mr. Breese was able to turn the small Honolulu zoo into one of the country's finest. Mr. Breese was a longtime member and ardent supporter of AAZK and animal keepers and was a frequent contributor and collaborator with the *Animal Keepers' Forum.*

Gary Clarke
Former Director - Topeka Zoo. In 1963, Clarke, became the Topeka Zoo's first director and remained as director until his resignation in 1989. Mr. Clarke was a founding member of a group who drafted papers for the zoo accrediting organization American Association of Zoological Parks and Aquariums (AAZPA). Gary Clarke became its first president in 1971. That organization is now the Association of Zoos and Aquariums (AZA).

Lutz Ruhe Meritorious Achievement - Professional of the Year Award

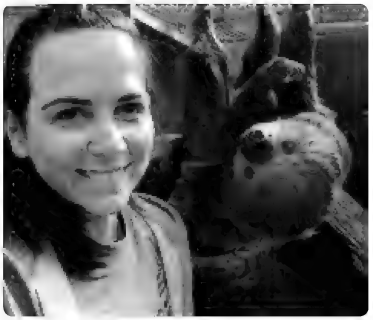
Alexis Williamson, Louisville Zoo. This award is based on her outstanding commitment to professionalism in her distinguished career as a zookeeper. Specifically noted are her conservation efforts which include contributions to Plinko for a Porpoise, generational record contributions for the gorillas housed at Louisville Zoo, and flagship conservation efforts for the black-footed ferret. In addition, she has been vital in the formation of the Enrichment Tree Program at Louisville Zoo while also serving on the enrichment committee. Finally, Alexis has been president of her AAZK Chapter for the past 14 years and has worked tirelessly to establish a relationship with the animals in her care in order to provide the best care possible. She is the consummate professional.

Jean M. Hromadka Excellence in Animal Care Award



Celine Pardo, Woodland Park Zoo. This award is based on Celine's outstanding efforts in Humboldt penguin husbandry. She achieved expertise from greater than 70 successful Humboldt penguin hatches in ten years. Celine's dedication to Humboldt penguin conservation and education both to the public and colleagues, her commitment to wild Humboldt penguin conservation and research, and Celine's several decades-long commitment to AAZK on a Chapter and national level is admirable.

Lee Houts Advancement in Enrichment Award



Ann Gutowski, Smithsonian's National Zoo, for demonstrating an excellent use of recycling and repurposing to build novel enrichment items for the animal inhabitants of the Small Mammal House. Ann demonstrated ingenuity and creativity when providing enrichment for animals in a mixed-species exhibit and she developed an enrichment schedule to ensure ease of preparation and novelty. Through her collaboration with her team, zoo nutritionists and management, Ann helped develop a weight loss and enrichment schedule for coatis and skunks which successfully lead to weight loss and the adoption of similar calendars for all animals in the collection. Ann strives to provide variability and goes above and beyond with environmental enrichment offerings.

Nico van Strien Leadership in Conservation Award

Mike Bona, Los Angeles Zoo and Botanical Gardens for his work in Giraffe Conservation. He created and developed "Laugh for Giraffes" and by bringing in partners, it has doubled the funds raised in one year. He has worked in field conservation in Kenya and Namibia. In addition, Mike is active on both local and national levels and increased the Chapter profile through local media. It is his mission to raise public awareness of the potential demise of giraffes.

Erica Royer, Smithsonian Conservation Biology Institute, runner-up for her integral work in breeding and increasing awareness of the extinct in the wild, Guam rail (*Hypotaenidia owstoni*). Erica assisted in a repatriation trip to reintroduce the rails into their native habitat; some were individuals that Erica helped hatch after decades of SCBI being unsuccessful. Erica trained the researchers in Guam on how to DNA sex eggs in order to improve their management. To raise awareness for the Guam rails, Erica pioneered the idea of hand-raising a male as an ambassador animal, which has allowed visitors to create a connection with a species they would not have known otherwise.

CONGRATULATIONS TO ALL THE AAZK AWARD WINNERS!

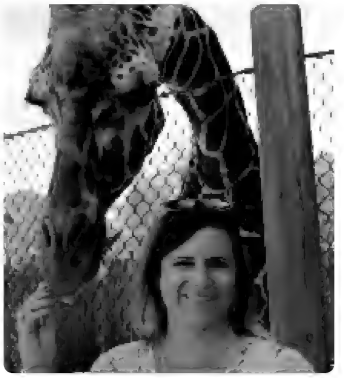
Christy Poelker, Saint Louis Zoo, for serving as Chair of the Conservation Committee

Ellen Vossekuil, Ochsner Park Zoo, for serving as Chair of the Professional Development Committee

Mary Ann Cisneros, Disney's Animal Kingdom Lodge, for serving on the AAZK Board of Directors and as Vice President

Certificate of Recognition

Jessica Biggins, Milwaukie County Zoo, for serving as Chair of the Grants Committee



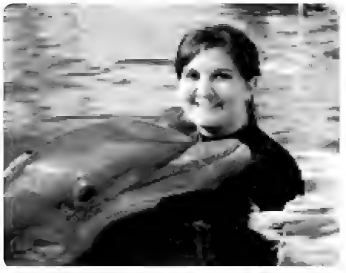
Bethany Bingham, Utah's Hogle Zoo, for serving on the AAZK Board of Directors and as Vice President and President

Kristen Scaglione, Akron Zoo, for serving as Vice Chair of the AAZK Resource Committee

Janet McCoy, Oregon Zoo, for serving as Chair of the Awards Committee 31 years

Kaitlyn Wiktor, Fort Wayne Children's Zoo, for serving as Vice Chair of the Behavioral Husbandry Committee

Hardy Kern, Columbus Zoo, for serving on the AAZK Board of Directors



Abbie Doan, Indianapolis Zoo, Denver Zoo, 2019 National AAZK Conference Chair

Bill Steele, Chicago Zoological Society at Brookfield Zoo, for serving on the AAZK Board of Directors

Certificate of Appreciation

Indianapolis Zoo
2019 AAZK National Conference
Host Institution

Distinguished Service Award

Indianapolis AAZK Chapter
2019 AAZK National Conference
Host Chapter

Barbara Manspeaker Chapter of the Year Award

Jacksonville AAZK Chapter
Jacksonville Zoo and Gardens

Certificate of Recognition Heroic Action Award

Marta Mathis, Elise Neuer, and Kelsie Bomke
Topeka Zoo

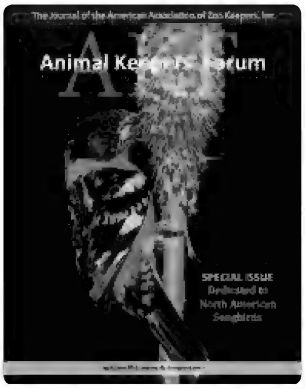
In the early morning of April 20, 2019 a male Sumatran Tiger attacked Kristyn Hayden-Ortega, a keeper at the Topeka Zoo and Conservation Center. Kristyn, the Chapter President of the Topeka Zoo AAZK Chapter suffered serious puncture wounds and cuts to her head, neck, back and both arms after entering the display enclosure without first securing tiger holding. After being initially alerted by zoo docents and zoo guests, Martha Mathis was first on the scene and immediately distracted the tiger away from Kristyn. Elise Neuer then arrived, secured the enclosure preventing tiger escape and began recall of the tiger to the holding building. Kelsie Bomke worked to recall the tiger into holding and secure the barrier between holding from the enclosure. The combined efforts of these three individuals saved the life of Kristyn Hayden-Ortega.

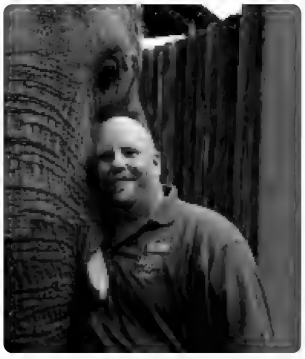
2019 AKF AWARDS

Celebrating excellence in journalism and photography

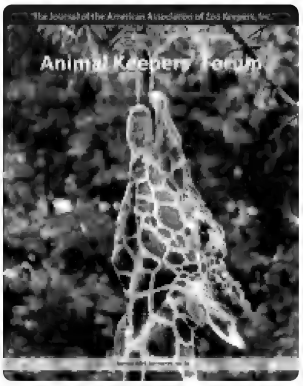
Cover Photography

PHOTOGRAPHER OF THE YEAR
Eric Peterson, Utah's Hogle Zoo
Black-headed Grosbeak





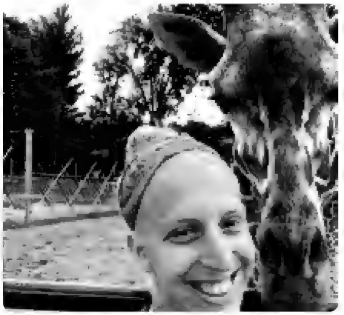
EXCELLENCE IN PHOTOGRAPHY
Scott Kayser, Birmingham Zoo
Reticulated Giraffe



Susan D. Chan
Author of the Year

Debra Dial, National Aquarium
Two-toed sloths (Choloepus didactylus): Ten years of husbandry and management at the National Aquarium

Lauren Starkey
Akron Zoological Park
Cans for Corridors: Building a permanent collection site through a Trees for You and Me grant.



Robin Sutker
The Virginia Living Museum (formerly from The Maryland Zoo in Baltimore)
How to Build a Better Zoo: Look to the keepers.

Heather Sinn
Columbus Zoo and Aquarium
Caring for an Aging King.

Nate Aalund
Saint Louis Zoo
Welfare in Zoo-housed Giraffe: A simple approach.

Lindsay Glass
Dallas Zoo
The Husbandry in Healing a Galapagos Tortoise (Chelonoides nigra) after Leg Surgery.

NZKW Video Contest Winner
Cincinnati Zoo

Diver: Eric Kohlhorst; Photographer: Kohlhorst

Divers use the custom-length Gentle Giant Tongs to safely feed a large Porcupine Pufferfish in the Coral Reef exhibit at the Newport Aquarium in Kentucky.

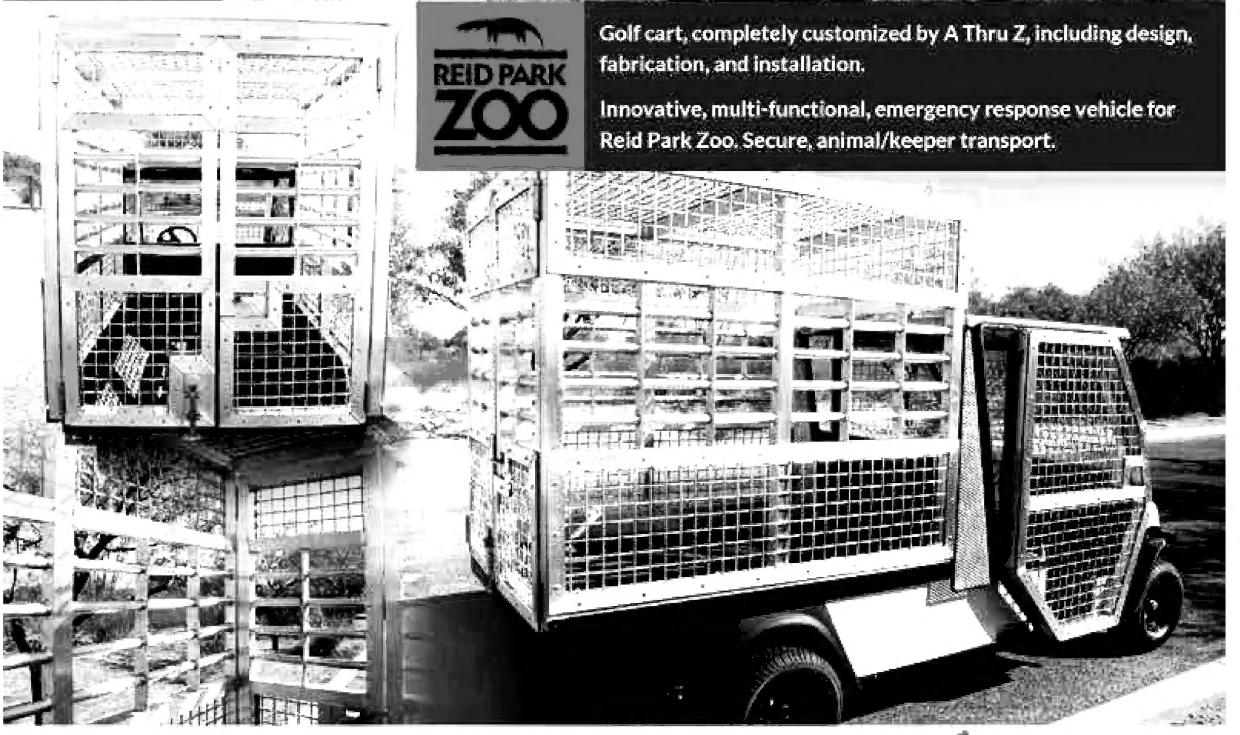
The tongs not only protect the diver's hands during feeding, but the animals associate the tongs with food, and become attracted to the red-coated tongs to make it easier to feed. Tongs help make transitions to a larger exhibit easier, as they become targeted to the red coated tongs.

All sizes of reaching tongs available from 15 inches to 25 feet in length.

REID PARK ZOO

Golf cart, completely customized by A Thru Z, including design, fabrication, and installation.

Innovative, multi-functional, emergency response vehicle for Reid Park Zoo. Secure, animal/keeper transport.



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Product/ Service Information

FEEDER TUBES

Photo Courtesy: The Maryland Zoo in Baltimore

Feeder Tubes engage the animal to interact with the tube to release the food. The standard configuration requires the animal to roll the Feeder Tube allowing the food to fall from the holes. The holes are offered in a 3/4" diameter or 1-1/2" diameter, custom size holes are also available at your request. Add eyebolts to the Feeder Tube when ordering and this will allow you to hang the Feeder Tube making the animal work harder to receive the food.

Feeder Tubes are available in Medium, Heavy, Extra Heavy and Severe Heavy Duty. Sizes are 6" diameter x 22" long, 7" diameter x 28" long, 10" diameter x 31" long, 12" diameter x 34" long and 14" diameter x 18" long.

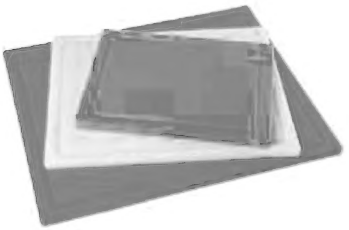
"Be the person your dog thinks you are."
-J. W. Stephens

Cutting Boards

All Cuttings boards are made from 1/2" thick commercial food-grade high density polyethylene. All are dishwasher safe and are textured on both sides with a liquid channel (trough) on one side only. Please contact us if you need liquid channels on both sides.

To reduce cross-contamination, all Cutting Boards are available in (6) colors: Red for Raw Meat, Adobe for Cooked Meat, Yellow for Poultry, Green for Produce, White for Dairy, and Blue for Fish.

Please contact us if you need a specific name permanently engraved into your Cutting Board (i.e. "Fish", "Raw Meat", Poultry", "Primates Only", "Big Cats" etc.) All Cutting Boards are available in (9) standard rectangular sizes and (3) unique styles. We can custom cut any size or shape.



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